

What is claimed is:

Add
A2
Add
B3
5

1. A method for locating a wireless mobile station in an area, wherein the area is included in a first area for a first network, and a second area for a second network, wherein:

the first network has a first collection of one or more base station controllers, wherein each of the base station controllers control communications with a corresponding predetermined plurality of geographically dispersed base stations of the first network, wherein each base station controller of said first collection has access to operating characteristics of mobile stations registered with the first network for subscribing to a first wireless service offered by the first network.

the second network has a second collection of one or more base station controllers, wherein each of the base station controllers in the second collection control communications with a corresponding predetermined plurality of geographically dispersed base stations of the second network, said second collection operably disjoint from said first collection, wherein each base station controller of said second collection has a more restricted access to at least one operating characteristic of mobile stations: (i) registered with the first network, and (ii) not registered with the second network for subscribing to a wireless service offered by the second network,

comprising:

receiving first data related to wireless signals communicated between a particular mobile station in the area and the first network, wherein said particular mobile station is registered with the first network;

first activating first location estimator for providing a first estimate of a location of the mobile station, wherein said first location estimator is supplied with first location information for deriving said first estimate, said first location

information at least partially derived from the first data, said location information capable of changing with a change in a location of said particular mobile station;

30 determining, from at least one of said first location information and said first estimate, a subset of one or more base station transceivers of the second network, wherein said subset is expected to include one or more base station transceivers:

(A1) detected by said particular mobile station, and

(A2) that detects said particular mobile station;

35 providing the second network with said at least one operating characteristic of said particular mobile station obtained from the first network;

obtaining, in response to said step of providing, additional location information derived at least partially from communications between said particular mobile station and said subset of transceivers related to wireless signals communicated between said particular mobile station and said subset of transceivers;

40 second activating a second location estimator for providing a second estimate of a location of said particular mobile station, wherein said second location estimator is supplied with said additional location information; and
outputting at least one of the first and second estimates of the location of the
45 mobile station as an estimate of the location of said particular mobile station.

2. A method as claimed in Claim 1, wherein said step of providing includes a prior step of populating a database with mobile station provisioning data, received from a customer care system used by said second network.

3. A method for locating a particular wireless mobile station during a wireless communication for an emergency response, wherein an area about said particular mobile station is included in a first area for a first wireless

4. A method as claimed in Claim 3, wherein one or more of said steps of selecting, second receiving, activating and outputting occur during said emergency response communication.
5. A method as claimed in Claim 3, wherein said step of outputting includes a step of transmitting said at least one location estimator to a Public Safety Answering Point.
6. A method as claimed in Claim 3, wherein said particular mobile station is not registered with said second wireless network.
7. method as claimed in Claim 3, further including a step of requesting that said particular mobile station scan for detecting signals transmitted by base station transceivers of the second network.
8. method as claimed in Claim 7, wherein said step of requesting includes providing a transmission to the first network, wherein said transmission instructs said particular mobile station to perform a scan for detecting signals transmitted by base station transceivers of the second network.
9. Method as claimed in Claim 8, wherein said step of receiving includes determining a base station transceiver identification of a base station transceiver from the second network.
10. A method as claimed in Claim 9, wherein said location related data includes an identification of first set of one or more base station transceivers of the first network such that for each said transceiver at least one of: (a) it detects said particular mobile station, and (b) it is detected by said particular mobile station; and

11. A method as claimed in Claim 10, further including a step of requesting that said transceivers of said second set scan for detecting signals transmitted by said particular mobile station.

12. A method as claimed in Claim 11, wherein said step of requesting includes providing a transmission to the second network, wherein said transmission instructs said second set of transceivers to perform a scan for detecting signals transmitted by said particular base mobile station.

13. A method as claimed in Claim 11, wherein said step of receiving includes determining measurements of wireless signals of a reverse path from said particular mobile station to said transceivers of said second set.

14. A method as claimed in Claim 3, wherein said step of determining includes activating at least one location estimator for providing at least two estimates of a location of said particular mobile station, wherein each said at least one location estimator is supplied with location information derived using at least one of said location related data and said additional location related data.

15. A method for locating a wireless mobile station, comprising:
receiving, by a receiving means, first data related to wireless signals communicated between a particular mobile station and at least a first network of a plurality of commercial mobile service provider networks, wherein for each said network, there are a plurality of base stations for at least one of transmitting and receiving wireless signals with a corresponding plurality of mobile stations registered with the network, and wherein said particular mobile station is registered with said first network for subscribing to a wireless service;

10 first activating a first location estimator for providing a first estimate of a
location of said particular mobile station, wherein said first location
estimator is supplied with first location information from said receiving
means for deriving said first estimate, said first location information
including data obtained using the first data, said location information
15 capable of changing with a change in a location of said particular mobile
station;

wherein when said location estimator supplied with said first location
information, said first estimate is one of: (a) is deemed ambiguous, (b) can not be
provided, (c) is not within a desired range of accuracy, and (d) has an extent greater
20 than or equal to a predetermined size, then the steps (A1) and (A2) are performed:

(A1) instructing said particular mobile station to communicate with a
second network of the plurality of networks for supplying second data
to said receiving means, wherein said particular mobile station is not
registered with said second network for subscribing to a wireless
25 service, and wherein said second data is [related to] derived using
wireless signals communicated between the mobile station and the
second network;

(A2) second activating a second location estimator for providing a second
estimate of a location of said particular mobile station wherein said
30 second location estimator is supplied with additional location
information from said receiving means, said additional location
information including data obtained using the second data;
outputting at least one of the first and second estimates of the location of the
mobile station as an estimate of the location of the mobile station.

16. A method for locating a wireless mobile station as claimed in Claim 15,
wherein said additional location information and said first location
information are utilized together by said location estimator.

17. A method of locating a wireless mobile station as claimed in Claim 15,
wherein said communication stations include wireless base stations for one
of CDMA, TDMA, and GSM.

18. A method of locating a wireless mobile station as claimed in Claim 17,
wherein said communication stations include home base stations.

19. A method of locating a wireless mobile station as claimed in Claim 15,
wherein the mobile station includes one of: a CDMA transmitter, a TDMA
transmitter, and a GSM transmitter, and a AMPS transmitter.

20. A method for locating a wireless mobile station as claimed in Claim 15,
wherein one or more of said activating steps includes:

- (a) said location estimator for determining whether the mobile station is
detected by a communication station which communicates with the mobile
station as a cordless telephone;
- (b) said location estimator for estimating a location of the mobile station using
location information related to data from a distributed antenna system;
- (c) said location estimator for estimating a location of the mobile station by one
of: triangulation and trilateration.

21. A method for locating a wireless mobile station as claimed in Claim 15,
wherein said predetermined extent is less than one thousand feet.

22. A method for locating a wireless mobile station, comprising:
first receiving first signal characteristic measurements of wireless signals
communicated between a mobile station and a first network of base stations,
wherein said base stations in the first network are cooperatively linked by a
first wireless service provider for providing wireless communication;
providing to a second network of cooperatively linked base stations for

providing wireless services to registered mobile stations, mobile station location data obtained using said first signal characteristic measurements, wherein said second network uses said mobile station location data for detecting wireless signals from the mobile station, and wherein said mobile station is a subscriber of said first wireless service provider's network and mobile station is not a subscriber of said second wireless service provider's network;

second receiving second signal characteristic measurements of wireless signals communicated between the mobile station and said second network of base stations; estimating a location of the mobile station using said first and second signal characteristic measurements

23. A method for locating a wireless mobile station, wherein the mobile station communicates via wireless signals with a wireless network infrastructure having a plurality of spaced apart base stations for wireless communication with said first mobile station, wherein said wireless network infrastructure identifies said mobile station by a first identifier for routing substantially all of its communications to said mobile station, comprising: providing an in-premise transceiver at a predetermined premise address for communicating with said mobile station, wherein said in-premise transceiver routes substantially all communication with said mobile station through a communications network that identifies said mobile station by a second identifier different from said first identifier, wherein the communications network uses said second identifier for routing substantially all of its communications to said mobile station; storing information relating the premise address and said second identifier; transmitting, by said in-premise transceiver, a status to the communications network when there is a change as to whether said mobile station and said in-premise transceiver are within a range of one another to wirelessly

communicate, wherein said status is indicative of said change;
storing, in a predetermined storage, said status, wherein a first value is stored
20 when said mobile station is within range for communicating with said in-
premise transceiver, and has a second value which is stored when said
mobile station communicates with said in-premise transceiver;
retrieving, using at least a portion of said information, said status from said
predetermined storage;
25 determining that the premise address is a location of said mobile station when
said first value is retrieved as a value for said status.

24. A method for locating a wireless mobile station, as claimed in Claim 23,
wherein said in-premises transceiver is a home base station.

25. A method for locating a wireless mobile station, as claimed in Claim 23,
wherein said predetermined storage is accessible via one of: autonomous
notification message and a request-response message.

26. A method for locating a wireless mobile station, as claimed in Claim 23,
wherein said predetermined storage is a home location register.

27. A method for locating a wireless mobile station, as claimed in Claim 23,
wherein said predetermined storage includes one or more of the following
data items related to said mobile station: mobile station identification
number, in-premise transceiver identification and mobile switch center
5 identification.

28. A method for locating a wireless mobile station, as claimed in claim 23,
wherein said step of transmitting further includes associating said change
with a predetermined fixed location and said in-premise transceiver
identification.

29. A method for locating a wireless mobile station, as claimed in Claim 23, further including a prior step of provisioning a translating database from a customer care system containing the location of the in-premise transceiver.
30. A method as claimed in Claim 23, wherein said communications network is physically connected by a wire to said in-premise transceiver for communicating with said mobile station.
31. A method as claimed in Claim 23, wherein said communications network includes a public switched telephone network.
32. A method as claimed in Claim 23, wherein said step of providing includes providing a correspondence in-premise transceiver and said mobile station that is used by said communications network for routing substantially all communications to said mobile station via said in-premise transceiver.
33. A method as claimed in Claim 23, wherein said steps of storing and retrieving include a step of notifying a service control point component of said communications network.
34. A method as claimed in Claim 23, wherein said step of retrieving includes accessing a home location register for said mobile station.
35. A method as claimed in Claim 23, wherein said step of retrieving is performed for determining when to route calls to said mobile station by said first identifier and when to route calls to said mobile station by said second identifier.

36. A method as claimed in Claim 23, wherein said step of retrieving is performed for redirecting a communication to said mobile station, wherein said redirecting is one of: (a) from said in-premise transceiver to said wireless network infrastructure, and (b) from said wireless network infrastructure to said in-premise transceiver.

5

37. A method as claimed in Claim 36, wherein said redirecting from said in-premise transceiver to said wireless network infrastructure is performed when said second value is retrieved in said step of retrieving.

38. A method as claimed in Claim 36, wherein said redirecting from said wireless network infrastructure to said in-premise transceiver is performed when said first value is retrieved in said step of retrieving.

39. A method for locating a wireless mobile station, comprising:
receiving data from wireless signals communicated between a mobile station and a wireless network including a plurality of distributed antennas;
detecting, using said data, that the mobile station is in wireless communication with [a] said distributed antenna system having a plurality of antennas connected in series and distributed along a signal conducting line so that there is a predetermined and purposefully introduced signal time delay between said antennas and at predetermined locations;
determining a plurality of signal time delay measurements for signals transmitted between the mobile station and a collection of some of said antennas, wherein said signals are also communicated through said line;
estimating a location of the mobile station using said plurality of signal time delay measurements.

5

10

40. A method for locating a wireless mobile station as claimed in Claim 39, wherein said step of estimating includes correlating each measurement of said plurality of signal time delay measurements with a unique corresponding one of said antennas.

41. A method for locating a wireless mobile station as claimed in Claim 39, wherein said step of estimating includes performing a triangulation using values related to one of: a signal time of arrival, and a signal time difference of arrival for time difference of arrival corresponding to each antenna in said collection.

42. A method for locating a wireless mobile station, as claimed in Claim 39 wherein said step of estimating includes a step of computing a most likely location of said mobile station using a fuzzy logic computation.

43. A method for locating a wireless mobile station as claimed in Claim 39, wherein said step of activating includes activating one of:

(a) a location estimator for determining whether the mobile station is detected by a base station of the network, wherein said base station communicates with the mobile station as a cordless telephone;

(b) a location estimator for estimating a location of the mobile station using location information obtained from said distributed antenna system;

(c) a location estimator for estimating a location of the mobile station by one of: triangulation and trilateration.

44. A method for locating a wireless mobile station, comprising:
first receiving first signal characteristic measurements of wireless signals communicated between a mobile station and a first network of base stations, wherein said base stations in the first network are cooperatively linked by a

5 first wireless service provider for providing wireless communication;
instructing the mobile station to search for a wireless signal from a second
network of base stations that are cooperatively linked by a second wireless
service provider for providing wireless communication, wherein said mobile
station is a subscriber of said first [and second wireless service providers are
10 different] wireless service provider, and said mobile station is not a
subscriber of said second wireless service provider;
second receiving second signal characteristic measurements of wireless
signals communicated between the mobile station and said second network
of base stations; estimating a location of the mobile station using said first
15 and second signal characteristic measurements.

45. A method for locating a wireless mobile station as claimed in Claim 44,
wherein the mobile station is registered for a wireless communication
service with the first wireless service provider, and the mobile station is not
registered for the wireless communication service with the second wireless
5 service provider.

46. A method for locating a wireless mobile station as claimed in Claim 44,
wherein said step of instructing includes transmitting a command to the
mobile station for instructing the mobile station to search for a signal from a
base station of said second wireless service provider in a frequency
5 bandwidth different from a frequency bandwidth for communicating with
the base stations of said first wireless service provider.

47. An apparatus for locating a first mobile station, wherein the first mobile
station communicates via wireless signals with a first wireless network
infrastructure having:
a plurality of spaced apart base stations for wireless communication with said
5 first mobile station, wherein at least one of said first mobile station and said

first wireless network infrastructure has a capability for obtaining a plurality of multipath measurements for one of: one or more forward transmissions to said first mobile station, and one or more reverse transmissions from said first mobile station to said first wireless network infrastructure, and wherein said multipath measurements are derived from both fixed clutter and variable clutter, comprising: [wherein said mobile switching center also communicates with said plurality of base stations for receiving measurements of said radio signals, said measurements including:

- (i) first measurements of said radio signals received by said first mobile station in said forward radio bandwidth, and (ii) second measurements of said radio signals transmitted by said first mobile station in said reverse radio bandwidth;]

a mobile station location determining system for locating said first mobile station, wherein said location determining system is capable of transforming [receives said first and second] values indicative of said multipath measurements for at least one of said forward transmissions and said reverse transmissions, wherein said transformed values have an enhanced dependence on multipath measurements derived from fixed clutter as compared to multipath measurements derived from variable clutter;

wherein said mobile station location determining system includes at least one wireless location determining model for estimating a location of said first mobile station, said at least one model uses one or more of said transformed values;

a means for transmitting, to said location determining system, said values indicative of said multipath measurements;

a means for outputting, from said location determining system, a resulting location estimate of said first mobile station.

48. An apparatus for locating a mobile station as claimed in Claim 47, further including a means for requesting data related to additional radio signals

between said first mobile station and at least a second wireless network infrastructure different from said first wireless network infrastructure.

49. An apparatus for locating a mobile station, comprising:

a wireless network infrastructure for communicating with a plurality of mobile stations, each said mobile station for transmitting and receiving wireless signals, wherein said wireless signals are received in a forward bandwidth and said wireless signals are transmitted in a different reverse bandwidth, and, said wireless network infrastructure having a plurality of spaced apart base stations for communicating via said wireless signals with said plurality of mobile stations;

a location determining means for communicating with said plurality of mobile stations, via said radio signals with the base stations, wherein said location determining means communicates with said plurality of base stations for receiving CDMA finger measurements related to said radio signals for estimating a location of at least a first of said plurality of mobile stations, said measurements including: (i) first measurements of said wireless signals received by said first mobile station in said forward radio bandwidth, and (ii) second measurements of said wireless signals transmitted by said first mobile station in said reverse radio bandwidth;

wherein said location determining means estimates a location of said first mobile station using both said first measurements and said second measurements.

50. An apparatus for locating a mobile station as claimed in Claim 5, wherein

said measurements include at least one of: a ratio of energy per bit versus signal to noise, a word error rate, a frame error rate, a mobile signaling means, a power control value, a pilot index, a finger identification, timeoffset, an identification of said first mobile station for communicating with the wireless network infrastructure, a make of said first mobile station,

a revision of said first mobile station, a sector identification of one of the base stations receiving said radio signals transmitted from said first mobile station.

51. An apparatus for locating a mobile station as claimed in Claim 49, wherein said location determining means receives said measurements from a distributed antenna system.

52. An apparatus for locating a mobile station as claimed in Claim 49, wherein said location determining means receives active, candidate and remaining set information from said first mobile signaling means.

53. A method for locating a wireless mobile station, as claimed in Claim 22, further including a step of requesting the mobile station to raise it's transmitter power level to a predetermined level, prior to said step of second receiving second signal characteristics measurements.

54. A method for locating a mobile station, comprising:

receiving, by said mobile station, a request control message from one of a plurality of base stations, wherein said message is received by a receiving antenna of said mobile station;

5 the control message providing information related to said message to at least one of a control processor and a searcher receiver in said mobile station;

10 determining, using at least one of said control processor and said searcher receiver, a plurality of multipath finger sets for a wireless communication between said mobile station and at least a first of the base stations, wherein for at least some of said multipath finger sets are different;

transmitting signals for said finger sets to one or more of the base stations via a transmitting antenna of said mobile station;

routing data for at least one of said finger sets from said one or more base stations to a mobile station location estimator for estimating a location of

15

said mobile station.

55. A method for locating a mobile station, as claimed in Claim 54, wherein each of said multipath finger sets includes at least a pilot offset identification value, an energy per bit over effective power spectral noise plus interference value, and a time offset value.

5

56. A method for locating a mobile station, as claimed in Claim 54, wherein said step of determining includes a step of instructing, by said control processor, said searcher receiver to output a plurality of said radio signal strength related values for a plurality of fingers resulting from said communication from said first base station to said mobile station.

5

57. A method for locating a mobile station, as claimed in Claim 54, further including a step of establishing a software controllable data connection between said control processor and a mobile station component including at least one of: a user digital baseband component and said modulator, wherein said connection inputs said data to said component.

5

56. A method for locating a mobile station, as claimed in claim 54 further said data for said fingers to a mobile station location estimation system having a first mobile station location estimating component using time difference of arrival measurements for locating said mobile station via one of trilateration and triangulation.

5

59. A method for locating a mobile station, as claimed in Claim 56, wherein said step of providing includes selecting one of: said first mobile station estimating component, a second mobile station estimating component using data obtained from a distributed antenna system, and a third mobile station estimating component for using data obtained from activation of a home

base station.

60. A method for locating a mobile station, as claimed in Claim 59, further including a step of computing a most likely location of said mobile station using a fuzzy logic computation.

61. A method for locating a mobile station, as claimed in Claim 60, wherein said step of computing is performed by said second mobile station estimating component for determining a most likely floor that said mobile station resides in a multi-story building having a distributed antenna system.

62. A method for obtaining data related to wireless signal characteristics, comprising:

providing a user with a mobile station for use when the user traverses a route having one or more predetermined route locations, wherein one or more of the route locations have a corresponding telephone number and a corresponding description stored in the mobile station;

performing the following substeps when the user visits each of the route locations: activating a call to said corresponding telephone number; transmitting a code identifying the route location when the user is substantially at the route location; storing an association of:

(a) signal characteristic measurements for wireless communication between the mobile station and one or more base stations, and

(b) a unique identifier for the route location obtained using said code transmitted by said call;

Wherein said stored signal characteristic measurements are accessible using said unique identifier.

63. A method as claimed in Claim 62, further including, prior to said step of activating, a step of determining, by the user, that a display on the mobile

station uniquely identifies that said corresponding description of the route location is available for calling said corresponding telephone number and transmitting said identifying code.

5

64. A method as claimed in Claim 62, wherein said step of storing includes using a phone number identifying the mobile station in combination with said transmitted identifying code for determining said unique identifier.

65. A method as claimed in Claim 62, wherein said corresponding description includes at least one of: a textual description of its corresponding route location, and an address of its corresponding route location.

66. A method as claimed in Claim 62, further including a step of filtering said signal characteristic measurements so that when said signal characteristic measurements are suspected of being transmitted from a location substantially different from the route location, said step of storing is one of: (a) not performed, and (b) performed so as to indicate that said signal characteristic measurements are suspect.

5

67. A method as claimed in Claim 66, wherein said step of filtering includes at least one of: (a) determining an amount by which an estimated location of the mobile station using said signal characteristic measurements differs from a location of the mobile station obtained from said unique identifier; (b) determining whether a predetermined amount of time has elapsed between successive performances of said step of activating.

5

68. A method for locating a wireless mobile station, comprising:
first receiving first signal characteristic measurements of wireless signals communicated between a mobile station and a first network of base stations,

wherein said first signal characteristic measurements includes:

- 5 (a) one or more multipath finger data sets for a wireless communication between the mobile station and at least a first of the base stations;
- (b) data identifying operational characteristics of the mobile station including information related to a signal transmission power for the mobile station and information for determining a maximum
- 10 transmission power level of the mobile station;
- adjusting, for at least one of said data sets, using said data, data set has the corresponding adjusted value wherein said adjusted value is an expected value of a predetermined standardized mobile station transmitter power level having a predetermined maximum transmission power and operating at
- 15 a predetermined transmission power level;
- outputting second signal characteristic information, obtained using said adjusted signal strength, to a mobile station location estimator for determining a location estimate of said first mobile station.

69. A method for locating a mobile station as claimed in Claim 68, further including applying a sequence of one or more signal processing filters to one of: said data sets and said adjusted data sets.

70. A method for locating a wireless mobile station, comprising:

first receiving first signal characteristic measurements of wireless signals communicated between a mobile station and a first network of base stations, wherein said first signal characteristic measurements includes one or more multipath finger measurement sets for a wireless communication between

5 the mobile station and at least a first of the base stations;

categorizing said sets into categories according to ranges of related values for obtaining a representation of a frequency of occurrence of said one or more pairs in said categories;

10 applying one or more filters to said categorizing sets for one of: (a) reducing

characteristics of said representation that are expected to be insufficiently repeatable for use in identifying a location of the mobile station, and (b) enhancing a signal to noise ratio;

- 15 supplying an output obtained from said step of applying to a mobile station location estimator;
estimating a location of the mobile station using said mobile station location estimator.

71. An apparatus for locating a mobile station as claimed in Claim 47, further including a means for providing a location estimate using the Internet.

72. An apparatus for locating a mobile station as claimed in Claim 47, further including a means for providing a location estimate using digital certificate keys and the Internet.

73. apparatus for locating a mobile station as claimed in Claim 72, further including a means for providing a location estimate using push technology on the Internet.

74. An apparatus as claimed in Claim 73, wherein said means for outputting includes an Internet web site for transmitting said resulting estimate location from said location determining system to a predetermined Internet address.

75. An apparatus as claimed in Claim 74, further including encryption/decryption modules for providing secure Internet communications between said Internet web site and said predetermined Internet address.

76. An apparatus as claimed in Claim 75, wherein said predetermined Internet address corresponds to an Internet receiving client at an emergency

assistance service center, wherein an identification of said first mobile station is provided to said emergency assistance service center substantially concurrently with the location of said first mobile station being transmitted to said location determining system.

77. An apparatus as claimed in Claim 76, wherein said receiving client is used at an emergency response center.

78. A method for locating a first mobile station, wherein the first mobile station communicates via wireless signals with a first wireless network infrastructure having a plurality of spaced apart base stations for wireless communication with said first mobile station, wherein at least one of said first mobile station and said first wireless network infrastructure has a capability for obtaining a plurality of multipath measurements for one of: one or more forward transmissions to said first mobile station, and one or more reverse transmissions from said first mobile station to said first wireless network infrastructure, and wherein said multipath measurements are derived from both fixed clutter and variable cluster, comprising: transmitting, from said first wireless network infrastructure to a location determining system, values indicative of said multipath measurements; transforming said values indicative of said multipath measurements for at least one of said forward transmissions and said reverse transmissions, wherein said transformed values have an enhanced dependence on multipath measurements derived from fixed clutter as compared to multipath measurements derived from variable cluster; determining at least one wireless location estimate of said first mobile station using one or more of said transformed values; outputting said location estimate of said first mobile station.

79. A method as claimed in Claim 78, wherein said first mobile station and said

del A2

[illegible]